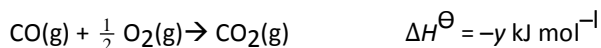


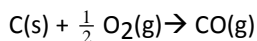
## T05D07 – IB SL Energetics 2011 Exam for REVIEW

Name.....

1. The following equations show the oxidation of carbon and carbon monoxide to carbon dioxide.



What is the enthalpy change, in  $\text{kJ mol}^{-1}$ , for the oxidation of carbon to carbon monoxide?



- A.  $x + y$   
 B.  $-x - y$   
 C.  $y - x$   
 D.  $x - y$

(Total 1 mark)

2. What energy changes occur when chemical bonds are formed and broken?

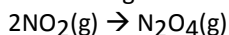
- A. Energy is absorbed when bonds are formed and when they are broken.  
 B. Energy is released when bonds are formed and when they are broken.  
 C. Energy is absorbed when bonds are formed and released when they are broken.  
 D. Energy is released when bonds are formed and absorbed when they are broken.

(Total 1 mark)

3. The  $\Delta H^\ominus$  values for the formation of two oxides of nitrogen are given below.



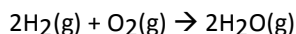
Use these values to calculate  $\Delta H^\ominus$  for the following reaction (in kJ):



- A. -105  
 B. -48  
 C. +66  
 D. +123

(Total 1 mark)

4. For the reaction



the bond enthalpies (in  $\text{kJ mol}^{-1}$ ) are

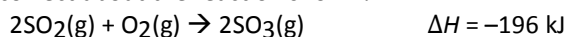
H-H	$x$
O=O	$y$
O-H	$z$

Which calculation will give the value, in  $\text{kJ mol}^{-1}$ , of  $\Delta H^\ominus$  for the reaction?

- A.  $2x + y - 2z$   
 B.  $4z - 2x - y$   
 C.  $2x + y - 4z$   
 D.  $2z - 2x - y$

(Total 1 mark)

5. Which statement is correct about the reaction shown?



- A. 196 kJ of energy are released for every mole of  $\text{SO}_2(\text{g})$  reacted.  
 B. 196 kJ of energy are absorbed for every mole of  $\text{SO}_2(\text{g})$  reacted.  
 C. 98 kJ of energy are released for every mole of  $\text{SO}_2(\text{g})$  reacted.  
 D. 98 kJ of energy are absorbed for every mole of  $\text{SO}_2(\text{g})$  reacted.

(Total 1 mark)

6. Which statement about bond enthalpies is correct?

- A. Bond enthalpies have positive values for strong bonds and negative values for weak bonds.  
 B. Bond enthalpy values are greater for ionic bonds than for covalent bonds.  
 C. Bond breaking is endothermic and bond making is exothermic.  
 D. The carbon-carbon bond enthalpy values are the same in ethane and ethene.

(Total 1 mark)

7. Which statement is correct for an endothermic reaction?
- The products are more stable than the reactants and  $\Delta H$  is positive.
  - The products are less stable than the reactants and  $\Delta H$  is negative.
  - The reactants are more stable than the products and  $\Delta H$  is positive.
  - The reactants are less stable than the products and  $\Delta H$  is negative.

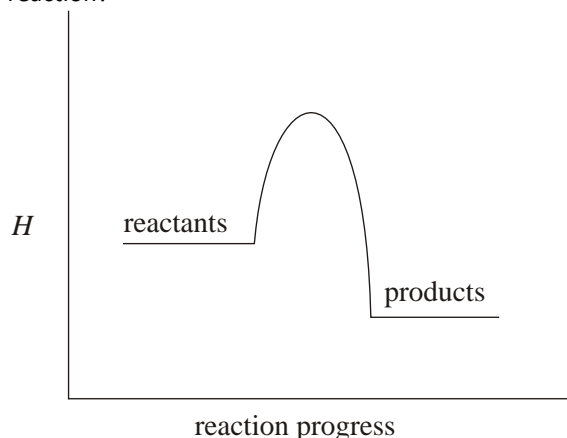
(Total 1 mark)

8. Which combination is correct for a chemical reaction that absorbs heat from the surroundings?

	Type of reaction	$\Delta H$ at constant pressure
A.	Exothermic	Positive
B.	Exothermic	Negative
C.	Endothermic	Positive
D.	Endothermic	Negative

(Total 1 mark)

9. According to the enthalpy level diagram below, what is the sign for  $\Delta H$  and what term is used to refer to the reaction?



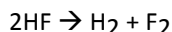
	$\Delta H$	reaction
A.	positive	endothermic
B.	negative	exothermic
C.	positive	exothermic
D.	negative	endothermic

(Total 1 mark)

10. Approximate values of the average bond enthalpies, in  $\text{kJ mol}^{-1}$ , of three substances are:

H-H	430
F-F	155
H-F	565

What is the enthalpy change, in kJ, for this reaction?



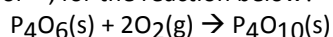
- +545
- +20
- 20
- 545

(Total 1 mark)

11. The standard enthalpy change of formation values of two oxides of phosphorus are:



What is the enthalpy change, in  $\text{kJ mol}^{-1}$ , for the reaction below?



- +4600
- +1400
- 1400
- 4600

(Total 1 mark)

12. The temperature of a 2.0 g sample of aluminum increases from 25°C to 30°C.

How many joules of heat energy were added? (Specific heat of Al =  $0.90 \text{ J g}^{-1} \text{ K}^{-1}$ )

- A. 0.36
- B. 2.3
- C. 9.0
- D. 11

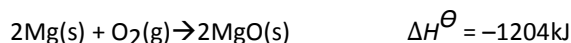
(Total 1 mark)

13. A simple calorimeter was used to determine the enthalpy of combustion of ethanol. The experimental value obtained was  $-920 \text{ kJ mol}^{-1}$ . The Data Booklet value is  $-1371 \text{ kJ mol}^{-1}$ . Which of the following best explains the difference between the two values?

- A. incomplete combustion of the fuel
- B. heat loss to the surroundings
- C. poor ventilation in the laboratory
- D. inaccurate temperature measurements

(Total 1 mark)

14. The following equation shows the formation of magnesium oxide from magnesium metal.



Which statement is correct for this reaction?

- A. 1204 kJ of energy are released for every mol of magnesium reacted.
- B. 602 kJ of energy are absorbed for every mol of magnesium oxide formed.
- C. 602 kJ of energy are released for every mol of oxygen gas reacted.
- D. 1204 kJ of energy are released for every two mol of magnesium oxide formed.

(Total 1 mark)

15. The average bond enthalpy for the C—H bond is  $412 \text{ kJ mol}^{-1}$ . Which process has an enthalpy change closest to this value?

- A.  $\text{CH}_4\text{(g)} \rightarrow \text{C(s)} + 2\text{H}_2\text{(g)}$
- B.  $\text{CH}_4\text{(g)} \rightarrow \text{C(g)} + 2\text{H}_2\text{(g)}$
- C.  $\text{CH}_4\text{(g)} \rightarrow \text{C(s)} + 4\text{H(g)}$
- D.  $\text{CH}_4\text{(g)} \rightarrow \text{CH}_3\text{(g)} + \text{H(g)}$

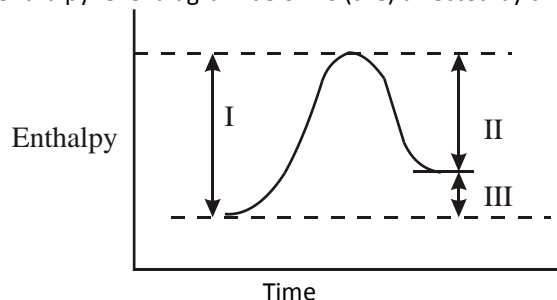
(Total 1 mark)

16. For which of the following is the sign of the enthalpy change different from the other three?

- A.  $\text{CaCO}_3\text{(s)} \rightarrow \text{CaO(s)} + \text{CO}_2\text{(g)}$
- B.  $\text{Na(g)} \rightarrow \text{Na}^+\text{(g)} + \text{e}^-$
- C.  $\text{CO}_2\text{(s)} \rightarrow \text{CO}_2\text{(g)}$
- D.  $2\text{Cl(g)} \rightarrow \text{Cl}_2\text{(g)}$

(Total 1 mark)

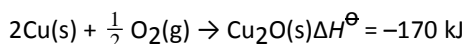
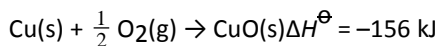
17. Which of the quantities in the enthalpy level diagram below is (are) affected by the use of a catalyst?



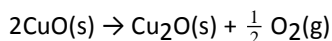
- A. I only
- B. III only
- C. I and II only
- D. II and III only

(Total 1 mark)

18. Using the equations below



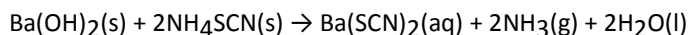
what is the value of  $\Delta H^\ominus$  (in kJ) for the following reaction?



- A. 142
- B. 15
- C. -15
- D. -142

(Total 1 mark)

19. When the solids  $\text{Ba(OH)}_2$  and  $\text{NH}_4\text{SCN}$  are mixed, a solution is produced and the temperature drops.



Which statement about the energetics of this reaction is correct?

- A. The reaction is endothermic and  $\Delta H$  is negative.
- B. The reaction is endothermic and  $\Delta H$  is positive.
- C. The reaction is exothermic and  $\Delta H$  is negative.
- D. The reaction is exothermic and  $\Delta H$  is positive.

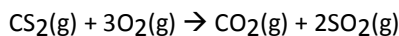
(Total 1 mark)

20. What is the energy change (in kJ) when the temperature of 20 g of water increases by  $10^\circ\text{C}$ ?

- A.  $20 \times 10 \times 4.18$
- B.  $20 \times 283 \times 4.18$
- C.  $\frac{20 \times 10 \times 4.18}{1000}$
- D.  $\frac{20 \times 283 \times 4.18}{1000}$

(Total 1 mark)

21. What is  $\Delta H$  for the reaction below in kJ?



$[\Delta H_f / \text{kJ mol}^{-1}: \text{CS}_2(\text{g}) 110, \text{CO}_2(\text{g}) -390, \text{SO}_2(\text{g}) -290]$

- A. -570
- B. -790
- C. -860
- D. -1080

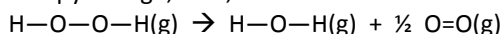
(Total 1 mark)

22. Which statements about exothermic reactions are correct?

- I. They have negative  $\Delta H$  values.
  - II. The products have a lower enthalpy than the reactants.
  - III. The products are more energetically stable than the reactants.
- A. I and II only
  - B. I and III only
  - C. II and III only
  - D. I, II and III

(Total 1 mark)

23. The average bond enthalpies for  $\text{O}-\text{O}$  and  $\text{O}=\text{O}$  are 146 and  $496 \text{ kJ mol}^{-1}$  respectively. What is the enthalpy change, in kJ, for the reaction below?



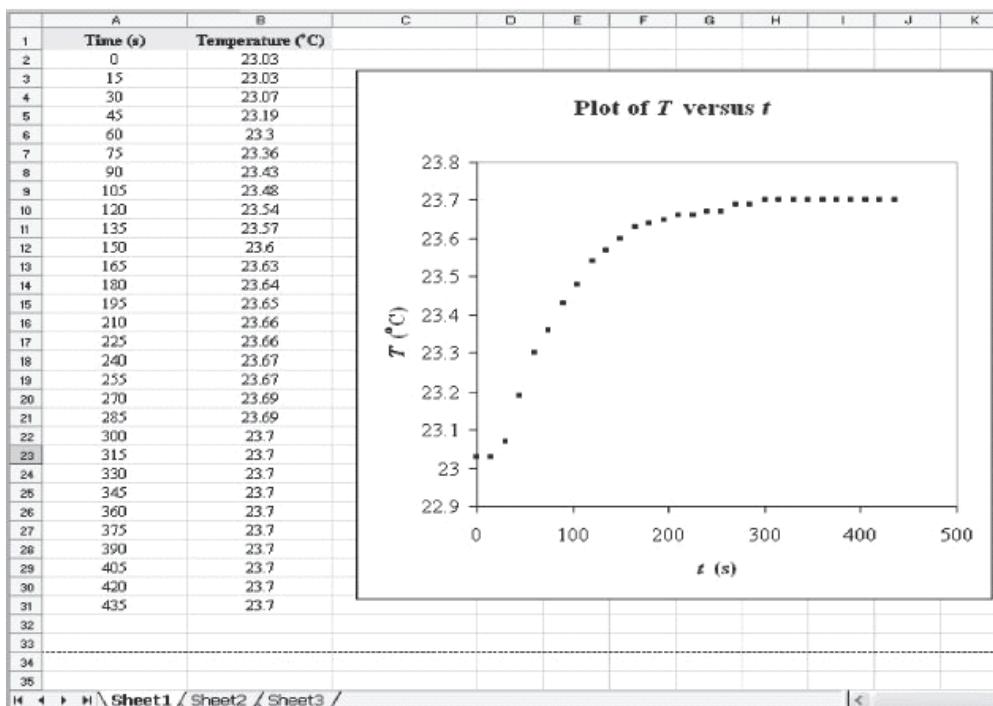
- A. -102
- B. +102
- C. +350
- D. +394

(Total 1 mark)

24. A sample of a metal is heated. Which of the following are needed to calculate the heat absorbed by the sample?
- The mass of the sample
  - The density of the sample
  - The specific heat capacity of the sample
- A. I and II only  
 B. I and III only  
 C. II and III only  
 D. I, II and III

(Total 1 mark)

25. The data below is from an experiment used to measure the enthalpy change for the combustion of 1 mole of sucrose (common table sugar),  $C_{12}H_{22}O_{11}(s)$ . The time-temperature data was taken from a data-logging software programme.

Mass of sample of sucrose,  $m = 0.4385 \text{ g}$ Heat capacity of the system,  $C_{\text{system}} = 10.114 \text{ kJ K}^{-1}$ 

- (a) Calculate  $\Delta T$ , for the water, surrounding the chamber in the calorimeter.

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(1)

- (b) Determine the amount, in moles, of sucrose.

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(1)

- (c) (i) Calculate the enthalpy change for the combustion of 1 mole of sucrose.

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(1)

- (ii) Using Table 12 of the Data Booklet, calculate the percentage experimental error based on the data used in this experiment.

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(1)

(d) A hypothesis is suggested that TNT, 2-methyl-1,3,5-trinitrobenzene, is a powerful explosive because it has:

- a large enthalpy of combustion
- a high reaction rate
- a large volume of gas generated upon combustion

Use your answer in part (c)(i) and the following data to evaluate this hypothesis:

	Equation for combustion	Relative rate of combustion	Enthalpy of combustion / $\text{kJ mol}^{-1}$
Sucrose	$\text{C}_{12}\text{H}_{22}\text{O}_{11}(\text{s}) + 12\text{O}_2(\text{g}) \rightarrow 12\text{CO}_2(\text{g}) + 11\text{H}_2\text{O}(\text{g})$	Low	
TNT	$2\text{C}_7\text{H}_5\text{N}_3\text{O}_6(\text{s}) \rightarrow 7\text{CO}(\text{g}) + 7\text{C}(\text{s}) + 5\text{H}_2\text{O}(\text{g}) + 3\text{N}_2(\text{g})$	High	3406

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(3)

(Total 7 marks)

27. The reaction between ethene ( $\text{CH}_2=\text{CH}_2$ ) and hydrogen gas is exothermic.

(i) Write an equation for this reaction.

(1)

(ii) Deduce the relative stabilities and energies of the reactants and products.

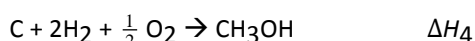
(2)

(iii) Explain, by referring to the bonds in the molecules, why the reaction is exothermic.

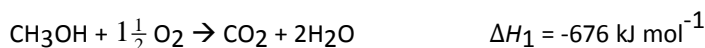
(2)

(Total 5 marks)

28. Calculate the enthalpy change,  $\Delta H_4$  for the reaction



using Hess's Law and the following information.



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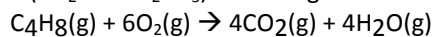
(Total 4 marks)

29. (a) Define the term *average bond enthalpy*.

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(2)

- (b) Use the information from Table 10 in the Data Booklet to calculate the enthalpy change for the complete combustion of but-1-ene ( $\text{CH}_2=\text{CHCH}_2\text{CH}_3$ ) according to the following equation



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(3)

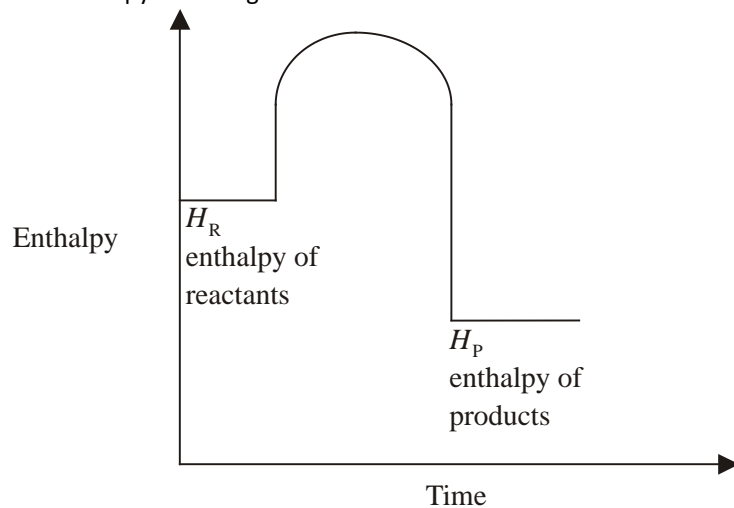
- (c) Predict, giving a reason, how the enthalpy change for the complete combustion of but-2-ene ( $\text{CH}_3\text{CH}=\text{CHCH}_3$ ) would compare with that of but-1-ene ( $\text{CH}_2=\text{CHCH}_2\text{CH}_3$ ) based on average bond enthalpies.

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(1)

- (d) The enthalpy level diagram for a certain reaction is shown below.



State and explain the relative stabilities of the reactants and products.

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(2)

(Total 8 marks)